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ABSTRACT

To explore the relationship of four sets of factors on Mexican American and Anglo American students' desire to take science courses (enjoyment of science, grades, importance of science, and self image), data were gathered from ninth grade students at three high schools in southern Arizona, by using questionnaires for students and interviews with parents and teachers. Analyses compared the pattern of association between the variables in each sex and ethnic group to determine whether different factors were related to taking science or if the same factors were involved but the strength of the relationships varied by sex and ethnicity. Results indicated that Anglo males had a greater interest than females or Mexican American males in taking science courses, and that Mexican Americans were more influenced by affective orientation toward science than Anglos. Suggestions were: better career education as a means of increasing students' awareness of science careers and the importance of learning science for a variety of occupations; changes in the science curriculum to strengthen applicability of course material to occupations and to understanding the world; and further research on factors contributing to ethnic differences in science grades (e.g., improvement in basic skills for Mexican Americans where necessary). (AN)

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Interest in Science Courses and Careers: A Comparison of Mexican-American and Anglo Students*

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Social scientists who study education and occupations have been particularly concerned with the effects of race, ethnicity and gender on occupational stratification. The general conclusion of these studies is that the higher the occupation in terms of the status and prestige, the fewer the number of women and minorities who are found (Blau, 1979). Occupational segregation by sex and ethnicity is particularly evident in science, which until recently was almost exclusively the domain of white males. Science may be a last bastion of white male dominance because the scientific professions required advanced, specialized training and are occupations that are highly regarded in our technologically oriented society.

Although women remain underrepresented in science, in the last ten years they have improved their position relative to men. In education, women's share of bachelor's, master's, and doctoral degrees in the biological and physical sciences increased from 1971 to 1977 (Brown, 1979). In 1977, women received 24% of all doctoral degrees, 21 percent of those in biological sciences and 9.6 percent of these awarded in physical sciences. These trends are likely to continue insofar as graduate enrollments in 1978 indicate that women represent 46 percent of all graduate students, thirty-five percent in the biological sciences and eighteen percent in the physical sciences (National Science Foundation, 1980a). In terms of work, the employment of women scientists increased faster than men between 1976 and 1978 (National Science Foundation, 1980b). The result is an increase in the percentage of employed scientists who are women.

While the participation of minorities in science has increased, minorities remain greatly underrepresented. Minorities represented 18 percent of all undergraduates in 1978 and comprised seventeen percent and ten percent of the majors in the biological and physical sciences respectively (National Science Foundation, 1980a). Although 10 percent of all graduate students were minorities, seven percent of the biological and six percent of the physical science students are

minorities. Thus, minorities are underrepresented as science students since blacks, Native Americans and hispanics accounted for 18 percent of the population.

When the minorities are separated into their respective groups, the differences between the ethnic groups become apparent. Relative to their size, Asian and Native Americans earn a more representative share of degrees in science than do blacks and hispanics. Hispanics are estimated to be nearly 6 percent of the U.S. population. However, hispanics received less than 2 percent of the bachelor's degrees and less than 1 percent of the master's and doctoral degrees in science in 1975-76 (National Science Foundation, 1980a). In terms of employment the figures indicate that in 1974 five percent of all employed scientists and engineers were minority group members; however, a mere .001 percent of all employed scientists and engineers were Mexican Americans (National Science Foundation, 1977).

The effect of being both a woman and a minority magnifies the barriers to participation in science. Because the percentage of degrees in science which are awarded to minorities is small, the figures are not broken down by sex. In employment, only one percent of all employed scientists and engineers were minority women in 1974 (National Science Foundation, 1977). The percentage of these women who are hispanic is probably quite small. Even though, the position of minority women in science is not well documented in terms of statistics, the obstacles to their success in education and employment have been explored in interviews and conferences with minority women scientists (Malcolm, Hall and Brown, 1976; Erlich and Lebold, 1977; Menard, 1979). The studies demonstrate that these women have persevered in spite of experiencing racism and sexism in their training and careers. The minority women were seen as different in both the scientific professions and in their own cultural group

because of their nontraditional career choice.

Numerous explanations of the effects of sex and ethnicity on participation in science have been offered. This paper will explore the relationship of four sets of factors on students' desire to take science courses: enjoyment of science, grades, importance of science, and self image. The analyses will compare the pattern of association between the variables in each sex and ethnic group. This strategy will help determine whether different factors are related to taking science in the sex and ethnic groups or if the same factors are involved but the strength of the relationships varies by sex and ethnicity.

This research is part of a larger project entitled "Social Influences on the Participation of Mexican-American Women in Science." The research design included questionnaires for students and interviews with parents and teachers. The questionnaires gathered information from 2464 high school and junior high school students on attitudes toward adult roles, attitudes toward school subjects, educational and occupational aspirations, family background, and personal characteristics. The six schools included in the study are located in Nogales and Tucson, Arizona. They were selected because they serve a large proportion of minority students from primarily working class families. Students who identify themselves as Mexican or Mexican-American are the majority in each school.

This paper is based upon data from ninth grade students from three high schools. In two schools Mexican Americans account for the vast majority of the ninth graders (seventy and seventy-six percent). In the third school, the ethnic distribution is forty-seven percent Mexican American, thirty-five percent Anglo, and eighteen percent other minorities, primarily blacks and Native Americans. Preliminary analyses indicated that there were no significant differences between the schools on the variables of interest. Therefore, the analyses presented below compare the responses of Mexican-American students (N=248) and Anglo students (N=82).

The science curriculum is designed as a sequential course of study. Students who are going on to college are expected to take biology, chemistry and perhaps physics and/or an elective science course. Many students, however, do not take science courses throughout their high school careers. These students limit their educational and career options by failing to enroll in advanced science and mathematics courses. Many students complete only the minimum required for graduation - one laboratory science course. These students obviously will be at a disadvantage if they pursue any post-high school education and the possibility of specializing in science will be reduced. Therefore, it is important to focus on ninth grade since most students complete the science requirement in this grade and are faced with deciding whether to take more science.

As indicated in Table 1, students' interest in taking more science varies by sex and ethnicity. Anglo males are the most likely to say they would take more science. Chi square tests indicate that Anglo males are significantly different from both Mexican-American males and females in their interest in taking science. The issue to be explored is what factors are related to interest in taking science.

The first factor to be examined involves enjoyment of science. Students were asked to indicate whether math, English, science or social studies was their favorite subject. They were also asked which of these subjects they disliked the most. In all four groups, science as the favorite subject is significantly related to interest in taking science. This relationship is stronger for Mexican Americans compared to Anglos even though Anglo males are more likely to pick science as their favorite subject than any other group. Second, disliking science is associated with not wanting to take science only among Mexican Americans. The percentage of students who dislike science does not vary by sex and ethnicity.[1] These results indicate that Mexican-Americans are more influenced by affective orientation toward science than Anglo students.

The second factor is grades in science. It has been argued that Mexican Americans receive lower grades in science and math than Anglo students because these subjects are not emphasized in their culture. Therefore, one would expect Mexican Americans to care less about grades in science and to try less than Anglos in Science. Students were asked what grades they usually got in science, how much they cared about getting good grades in science, and how hard they tried to do better when they found they weren't learning the subject. Grades are related to interest in science in three of the four groups. Generally, students who are doing better in science are more likely to want to take science. By the ninth grade, Anglos are at an advantage compared to Mexican Americans in that they receive higher grades in science. The ethnic differences presented in Table 3 are significant although the sex differences are not. As evident in all four groups, students who care more about their grades in science are more likely to be interested in taking science. Mexican-American males, however, care less about their grades than Anglo males. Thus, achievement as assessed by grades is related to interest in science, and the evidence suggests that part of the ethnic difference in interest in science is due to the lower grades Mexican Americans receive.

One explanation frequently offered is that Mexican-American expend less effort than Anglos in various subjects. The data from this study refute this explanation. Among males, there is no difference in students' assessment of how hard they try. Among females, Mexican-Americans rate their effort in science higher than Anglos do. So it is not that Mexican Americans try less hard to learn science. In fact, effort is related to interest in taking science among Mexican Americans but not among Anglos. Thus, it appears that although Mexican

Americans try to do well, their effort is not reflected in their grades.

A second explanation of the ethnic differences in science grades focuses upon cognitive skills. It has been argued that cognitive styles characterized by logic, rationality, field independence facilitate achievement in science and math. This explanation has been used to explain the lower participation of both women and minorities in science and math. While ethnic and gender differences in specific cognitive skills have been found, the link between these cognitive skills and performance in math and science is not clearly established. For example, Ramirez (1977) presents evidence that the greater flexibility in the cognitive styles of bicultural students is related to the ability to respond to a complex, changing environment, an ability which would seem to be related to achievement in science. If cognitive style is the crucial factor, one would expect a similar ethnic differences with respect to math, which also requires abstract, logical thinking and spatial skills. The data in this study indicate that there are no ethnic differences in grades received in math and how hard students try to learn math. There are differences in caring about grades in math. However, the differences are the opposite of those expected, i.e. Mexican Americans care more about math grades than Anglos do. Thus, the cognitive styles explanation is not supported.

A third explanation argues that Mexican Americans are less well prepared in basic skills (Espinoza, Fernández, and Dornbusch, 1977). Language may be particularly important insofar as skills in English may be more important in science than in math. Anderson and Johnson (1971) found that student's grades were related to their use of English outside of school. This explanation may account for the differences between grades in science and math. Subsequent analyses will test this explanation by exploring the effect of grades in English and use of English outside of school on grades in science and math.

The third set of factors involve the importance of science. Espinoza, Fernández and Dornbusch (1977) found that student's perception of the link between school and their future jobs influenced their assessment of the importance of school and the effort expended in school. This project elaborated the usefulness of science by asking students how important learning science is to future jobs, understanding the world around them, and making decisions about buying products. Science is generally perceived as not very important with respect to buying products. As shown in Table 2, the importance of science for jobs and for understanding life are related to interest in taking science in three of the four groups. For all but Mexican-American males, the more important learning science is perceived, the more interest in taking science. Thus, the link between science and the world outside of school influences students' continuing interest in science. There are no ethnic or sex differences in the perceived importance of science. Thus, Mexican Americans rate the importance of learning science as highly as Anglo students although for Mexican-American males these ratings are not reflected in interest in taking courses in science.

Occupational aspirations were also examined. The differences between males and females in the jobs to which they aspire are the largest differences found in this study. There are also significant variations by ethnicity. These findings suggest that the patterns of occupational segregation by sex and ethnicity may continue. As can be seen in Table 4, Anglo males are significantly more likely to aspire to be scientist than the other groups. Given the process of attrition throughout the educational system, few of the students who aspire to be scientist will complete the necessary training. When so few Mexican American students and Anglo females are interested in careers in science, their representation in science is unlikely to increase. Occupational aspirations are related to interest in science in three groups. These results were obtained

using numerous occupational categories. Examination of specific categories reveals the strength of the association. All of the students who want to be scientists said they would or would probably take science, followed by eighty to hundred percent of those aspiring to health related professions. Among those desiring non-professional jobs, between forty-five and seventy-five percent were interested or probably interested in taking more science.

The final set of factors examined are dimensions of self image. The explanation suggested is that Mexican Americans differ from other groups on traits that are related to achievement. Research has shown that Mexican Americans are less self confident and feel less mastery (Anderson and Evans, 1976) and less competitive (Kagan, Zahn, and Geally, 1977) than Anglo students. These characteristics are only moderately related to achievement. Research on women scientists also suggest that those who have managed to succeed in science describe themselves as creative, intelligent and self confident (Rossi, 1965; Helson, 1971; Malcolm, Hall and Brown, 1976; Menard, 1979). Thus, this research explored the connection between the characteristics self confident, competitive, intelligent and creative and interest in science. As can be seen in Table 5, these characteristics are essentially unrelated to interest in science courses. There are only two significant associations. Mexican-American females who see themselves as more intelligent and Anglo males who describe themselves as more creative are more likely to be interested in taking science.[2] These results indicate that these dimensions of self image do not contribute to interest in science among ninth graders. It may be that those who are successful in becoming scientists are significantly different in these characteristics because of the feedback and socialization they receive throughout their educations rather than because of initial differences in these traits based on childhood experiences.

The results of this research are part of an effort to determine factors that influence interest in science. This analysis has indicated that the greater interest of Anglo males in taking science courses compared to Mexican Americans can be attributed to three factors. The course decision making process appears to be influenced more by affective factors for Mexican Americans than Anglos. Regardless of whether they dislike science, Anglos are likely to continue taking science. Anglos appear to be more influenced by the instrumental value of science. The importance of science for their future jobs and for understanding the world are strongly related to interest in science courses for these students. Both of these explanations suggest that career education is necessary to increase students' awareness of careers in science and the importance of learning science for a variety of occupations. The finding that students occupational aspirations are related to interest in science courses substantiates this suggestion. Second, changes in the science curriculum that would strengthen the applicability of course material to understanding the world and to occupations would increase students' interest in science. Scientists can contribute by providing feedback about such changes in the curriculum and by making themselves accessible as role models. The third factor associated with interest in science is grades in science. Further research is needed to explore the factors that contribute to the ethnic difference in science grades. Insofar as Mexican Americans receive lower grades because they are less well prepared in basic skills and/or English, improving these skills may increase their chances of success in school in general and science in particular.

TABLE 1

Interest in Taking Science

If you had a choice, would you take Science next year?

	Anglo males	Anglo females	Mexican-American Males	Mexican-American Females
Yes	72%	54%	46%	38%
Probably	19	20	30	31
No	6	20	15	19
Don't Know	3	6	8	12
N	(32)	(50)	(123)	(125)

TABLE 2

Educational and Occupational Factors Associated with Interest in Taking Science

	Mexican-American Males	Mexican-American Females	Anglo males	Anglo females
Science favorite	***	***	*	**
science most disliked	***	**	n.s.	n.s.
science grade	n.s.	***	***	*
care about science	***	***	*	***
try in science	**	***	n.s.	n.s.
science and job	n.s.	***	***	**
science and life	n.s.	***	***	**
occupational aspirations	*	**	*	n.s.

Chi square significant at:
* .1 level
** .05 "
*** .01 "
n.s. not significant

TABLE 3

Grades in Science

	Anglo males	Anglo females	Mexican-American males	Mexican-American females
Mostly A's	39%*	29% **	15% *	21%**
Mostly B's	26	44	37	24
Mostly C's	22	19	34	34
Mostly D's	13	8	15	21

* significant ethnic difference within sex at .05 level
** significant ethnic difference within sex at .01 level

TABLE 4

	Anglo males	Anglo females	Mexican-American males	Mexican-American females
scientist	18%	2%	5%	1%
health related professional	6	8	8	11
math related professional	0	4	7	5
other professional and technical	9	28	17	17
all other occupations	67	58	63	66

TABLE 5

Association of Self-Image and Interest in Taking Science

	Mexican-American males	Mexican-American females	Anglo males	Anglo females
confident	n.s.	n.s.	n.s.	n.s.
competitive	n.s.	n.s.	n.s.	n.s.
intelligent	n.s.	**	n.s.	n.s.
creative	n.s.	n.s.	***	n.s.

Chi square significant at:
* .1 level
** .05 level
*** .01 level
n.s. not significant

NOTES

1 Anglo females are more likely than Anglo males to dislike science (at the .1 level). The other differences are not significant.

2 Although the self-image items are not related to interest in taking science, there are interesting sex and ethnic differences in the students' responses. Mexican American males and Anglo-females rate themselves as less intelligent than Anglo-males. Mexican-American females describe themselves as less self-confident, less competitive and less creative than Mexican American males.

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